# who owns what

## A mildly entertaining look into intellectual property in synthetic biology

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# A General Overview of Intellectual Property in Synthetic Biology: Part 2

**The Basis of Patent Law in Synthetic Biology: Software**

Synthetic biology research is pushing the bounds of what we once thought was possible in biology. Because of this, synthetic biology is also pushing the limits of how we as a society have defined ownership and property. While sixty years ago the question was inconceivable, today it is completely reasonable to ask, "can I patent a genome?" or, "can I own the property rights to a living creature?" These are big, important questions! Interestingly, the best answers the U.S. courts have to solving these questions comes from, of all places, the world of software.

Prior to the development of computers, intellectual property could be protected by trademarks, copyright laws, and patents. These classifications proved robust and effective up until the emergence of software applications. Software, unlike anything seen before, is a *written* programing language that results in a *function* or *utility*. Thus, it makes sense that one could copyright the contents of their code, and patent the functionality of their software tool. As some examples, Mario is a copyrighted character in Nintendo games, and the functionality of the Excel spreadsheet is patented under Microsoft.

People studying intellectual property rights in synthetic biology quickly realized that the closest example from which to draw a conclusion would be software. Software is similar to synthetic biology for multiple reasons; namely, developers (or researchers) create programs (or biological parts) that code for high level functions (such as transcriptional regulation). Therefore, today many of the intellectual property rights that define synthetic biology are drawn from software laws. As we compare intellectual property in synthetic biology to that in software, it is important to be aware of the differences between the two, the most important being that you can patent both DNA and software code for its function, but you *cannot* copyright DNA code, as you could for a piece of software. The patent system that has served to protect software for decades was adopted to protect intellectual properties in synthetic biology. This worked in protecting ideas like the genetic toggle switch, or the kill gene in Gateway Assembly, both of which were patented.

Unfortunately, the patent system in synthetic biology and software does not work in all cases. Namely, the system fails when 1) a patent is so broad that other researchers can't approach the patented technology with a ten-foot-pole without fear of infringement or 2) there is a cluster of narrower patents in a certain aspect of synthetic biology (e.g. digital genetic logic circuits) that prevents researchers from working on downstream applications due to possibility of infringement on one of the narrower patents. These issues of ambiguity in patent law in software, and now in synthetic biology, are described as the ***anti-commons*** problem. Anti-commons is a state in which new research or development is deterred because of ambiguity or overuse of patents in property rights. It is here that software developers and synthetic biologists encounter the same problem: how can the integrity of intellectual property be protected while still facilitating a dispersion of information to the greater scientific community? How can software developers protect and profit from their ideas, while still allowing the rest of the community to use those tools to build their own software? This translates to synthetic biology as: how can synthetic biologists working in foundational research develop biological parts that are protected, but are still available to the greater scientific community for further development into real-life applications?

*The answer to all of our problems is always 47! It's the answer to the Universe!*

Just kidding. The answer came in the form of the Open Source Initiative, which was launched in 1998 as an "general education and advocacy organization… focused specifically on explaining and protecting the 'open source' label". This idea of *open source software* fostered a community in which software developers share their creations in the public domain, and in return they can use the source code of all other people in the community. Now for our second to last definition (we promise!), the definition of open source; for a work to be considered open source, a developer must allow:

1. Open access to source code

Meaning, when the software is released, users *must* be able to obtain the code that the software was written with.

In the context of synthetic biology, that means that the genetic code and biological parts that went into making a new system must be released to the synthetic biology community.

1. Free redistribution

Meaning, you cannot restrict any person or party from selling or giving away the software as a component of a larger aggregate software distribution.

In the context of synthetic biology, this means that if you make a new system or genetic circuit, you cannot prohibit other researchers from using this system in their projects.

1. The ability to derive works without penalty

Meaning, a person or party must be allowed to modify and derive new software from the original software

In the context of synthetic biology, this would mean that if you develop a genetic circuit, other researchers would be able to modify and rederive new circuits or applications from your work.

There are other, less significant criteria that go into making something **open source** and could drag this blog post out forever (and we're trying to get to the cat videos when we're done), but the big take away point is that, ***for an invention to be open source, the components that went into making the invention***

***should be released to the public, be modifiable by the public, and the invention itself must be free for other people to incorporate into their own projects.*** Again, *open source* need not refer to just software, although today the most prominent open source movement is in the realm of software. This same idea applies to open source hardware, dubbed Open Hardware, and synthetic biology is also beginning to adopt this idea in the form of a synthetic biology **commons.** In a synthetic biology commons, patented genes and genetic parts (a.k.a. "source code") are licensed such that they can be used exclusively in the public domain, and are usable and modifiable by the greater scientific community.

One great example of a synthetic biology commons can be found in the BioBrick Foundation, which aims to create a standardized registry of well documented biological parts. This is the equivalent of having a registry of software tools and their source code, free for other developers to use. In the software world developers aimed to have a open source commons where all new code is shared, modified and redistributed; in the biology world some researchers are aiming to have a commons where all new genetic parts or systems are shared, and these creations can be used by other researchers worldwide to facilitate new research and innovation. However, we still have a long way to go.

**Notes from the Writers**

In this post you have (hopefully) learned a thing or two about the struggles faced by researchers and lawyers in intellectual property regarding synthetic biology and software. We've debuted multiple definitions, all of which will make more appearances in our posts in the near future. Also, to help you all out, we have created a concise list of these words and their definitions, if you're ever confused about a definition (if we didn't scare you away), all you need to do is come back here and take a look at post 3. With that, we hope you learned something, and till next time.

Yours,

Castor and Pollux

Castor and Pollux

Representing Neptune (BU Hardware) and Gemini (BU Wetlab)

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